Activity of the California Least Tern (*Sternula antillarum browni*) at Huntington State Beach Orange County, California

Prepared by
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INTRODUCTION

The California Least Tern *(Sternula antillarum browni*; hereafter Least Tern*)*, a state and federally listed endangered species, is a migratory, water-associated bird which returns to coastal California from Central America to breed between April and September. Adults are gray with white under-parts, black cap and lore with a white forehead, black-tipped wings, and a yellow beak with dark tip. Young birds are brownish-gray with a scaly appearance, black head lacking the white triangle on the forehead and a dark beak. California Least Terns are approximately 10 inches in length with a 30-inch wingspan. This once abundant, colonial nesting species inhabits seacoasts, beaches, estuaries, lagoons, lakes, and rivers and prefers to nest on bare or sparsely vegetated sand, soil, or pebbles. Least Tern nesting is characterized by two "waves" (Massey and Atwood 1981). The first wave is typically comprised of experienced breeders while the second wave is predominately three-year-old birds breeding for the first time. This second wave of nest initiations usually occurs starting in mid-June. Pairs that lose their first clutch and re-nest may also contribute to the group of second wave nesters. The nest of the Least Tern is a simple shallow scrape in the sand, sometimes lined with shells, pebbles, bits of wood, or plant material, and may contain one to three eggs. Both parents incubate the nest which hatches in approximately 21-23 days (Massey 1974). Adults forage for fish in near-shore waters, estuaries, lagoons, bays, and river mouths (Atwood and Kelly 1984). Fledging, or the ability to fly, for Least Terns usually occurs within three weeks of hatching. Early in their decline, Least Terns were collected to adorn women's hats. Today, habitat destruction is the biggest threat to this species as nesting habitat is prized for recreation and residential development. A second major threat is predation by animals such as birds of prey, coyotes, foxes, and domesticated or feral cats and dogs. El Niño weather patterns can also affect Least Tern populations by causing a northern shift in fish populations following cold water currents, resulting in a shortage of food for adult terns and their young.

In Los Angeles and Orange Counties, there are seven Least Tern nesting areas that have been utilized since 1986: Venice Beach, Los Angeles Harbor, Seal Beach National Wildlife Refuge, Bolsa Chica Ecological Reserve, Upper Newport Bay Ecological Reserve, Burris Basin, and Huntington State Beach. In 2016 a new colony, Anaheim Lake, was added to the list of active tern colonies in these counties. In 2016, a minimum of 636 breeding pairs were reported for these colonies (Frost 2016). A minimum of two pairs were documented at Venice Beach, 109 at Los Angeles Harbor, 73 at Seal Beach National Wildlife Reserve (NWR), 124 at Bolsa Chica Ecological Reserve, 18 at Upper Newport Ecological Reserve, six at Burris Basin, two at Anaheim Lake, and 304 at Huntington State Beach. The nesting area at Huntington State Beach (Figure 1) has been utilized by Least Terns for decades and has been an extremely important contributor to the recovery of the species.

The Huntington State Beach tern colony was designated a preserve in 1975 with 2.5 acres (Huntington State Beach General Development Plan, 1976). Over the years several changes were made, including increases in acreage and improvements to the fencing. In 1984 and 1985, the Huntington State Beach California Least Tern Natural Preserve consisted of about 6.4 acres (26,000 m^2) protected by chain-link and temporary sand fencing. This area was expanded to 7.5 acres (30,437 m^2) in 1986 and completely

surrounded with a five to seven-foot high chain link fence. In 1989, the fence was replaced with one designed to preclude entry by predators including the non-native red fox *(Vulpes vulpes)*, which had plagued the colony in preceding years. A cantilevered barrier was placed at the top, creating a net height of about eight feet which would prevent climbing or bounding over by mammalian predators. A strip of plastic aviary netting was partially buried along the entire base of the fence to keep chicks inside the fenced area and to prevent predators from burrowing under the fence.

In 1990, the alignment of some sections of the fence was modified to slightly enlarge the colony by about 1.1 acres which created an enclosed area of approximately 8.6 acres (34,872 m^2). In the winter of 2012-2013, the sand fence around the south side of the colony was replaced with the chain-link fencing used around the rest of the colony. Plastic netting was partially buried along the base of this fence to keep chicks inside. The sand fence was moved about 20 feet outside of this fencing to prevent sand from drifting on the permanent fence and burying the plastic netting. During the winter of 2016-2017, the fence that divided the main 7.5-acre colony and the 1.1-acre addition from 1990 was removed. This section of the fencing was used as a perch by falcons in the years immediately preceding years, in addition to acting as a barrier to more efficient monitoring within the colony. Chick fencing was also repaired, and 10,000CF of sand was spread on the beach in front of the colony to help repair damage from erosion the year before.

The Huntington State Beach colony was raked to clear vegetation in most years until 1985 (Pavelka and Stadtlander 1993). Since 1985, raking has occurred sporadically. The nesting area typically supports a widely spaced and low-stature population of beach primrose *(Camissoniopsis cheiranthifolia)*, and some sparse beach morning-glory *(Calystegia soldanella)*, sea rocket *(Cakile edentula)*, and beach sand verbena *(Abronia umbellata)*. The vegetation is now strategically cleared in an alternating grid pattern that is raked every other year, to maintain approximately 25% bare sand and allowing for various amounts of vegetative cover.

The U.S. Fish and Wildlife Service (USFWS) previously studied and reported on Least Tern nesting activity at the Huntington State Beach colony from 1986 through 1988 while the California Department of Fish and Wildlife (CDFW) monitored the colony in 1989 and 1990. The USFWS then resumed monitoring until 1993. In 2008, the Santa Ana Watershed Association (SAWA) and Orange County Water District (OCWD) began nest monitoring at Huntington State Beach. The work reported herein discusses the results of Least Tern monitoring efforts in 2017.

METHODS

Site Preparation

Prior to the 2017 breeding season, a limited amount of vegetation was raked in the colony. Grid markers were re-marked and roof tiles were cleaned out to offer additional shelter for chicks. Fencing surrounding the colony was mended and non-native vegetation was removed. Erosion damage from the previous year was also repaired.

Monitoring

In 2017, the Huntington State Beach colony was monitored twice per week from early May to early August for a total of 24 visits. Visits to the colony typically lasted about two to three hours for a total of 156.75 observer field hours. Two to three observers monitored inside the colony throughout the breeding season. Each observer covered about one-third to one-half of the colony. During each visit, all active nests were visually examined at close range to determine the number and condition of the eggs or chicks. Chicks and fledglings were counted into several age classes according to a protocol developed by CDFW. These ages classes are listed as downy chick, feathered chick, pre-fledge, younger fledgling, and older fledgling (Appendix A).

In previous years, portable blinds were used to monitor within the colony. In the 2017 breeding season, monitors intended to conduct an experiment alternating between using the blinds and not using the blinds, in order to determine their necessity. Due to falcon activity in the colony starting early in the season, the experiment was abandoned. The use of blinds was also abandoned as monitors discovered they could move quicker and see more around them, thus limit the time spent in the colony. This experiment will be reconsidered for next year. As monitors moved through the colony, nests were identified by placing two numbered tongue depressors into the sand approximately one foot from each nest on the ocean and up-coast sides. The location of each nest was marked on a colony map using a grid system. Each grid square was marked on the ground with a labeled PVC pipe in the north-east corner of the square, and is approximately 25 by 25 meters. State Park volunteers monitored the colony from outside the fence throughout the day during nesting season and notified the preserve manager of predators and other disturbances, preserve maintenance issues, and any other pertinent information.

During each monitoring visit, nest contents were recorded to determine clutch size and hatching success. Data analysis at the end of the season calculated the number of breeding pairs and total fledglings produced. In cases of nest or chick predation, efforts were made to determine the predatory species involved and assess the impact to the overall colony. Data were compiled and analyzed per CDFW protocol. Abandoned eggs were disposed of outside the colony at the end of the season to discourage scavenging.

Definitions

Hatching success: Number of eggs that hatched divided by the total number of eggs produced to give a percentage of hatched eggs.

Nesting attempt: A scrape with a minimum of one egg. Empty scrapes are disregarded.

Nesting success: Number of nests with at least one hatched egg divided by the total number of eggs to give a percentage of successful nests.

Pair estimation method I: Total number of nests in the first wave added to half the total nests in the second wave. The second wave nests are halved to conservatively assume half of those are re-nests.

Pair estimation method II: Number of failed nests and the estimated number of broods lost prior to June 20 subtracted from the total number of nests. The failed nests and lost broods are subtracted from the total to conservatively assume those pairs re-nested.

Pair estimation method III: Total pairs in wave one and total pairs in wave two. The number of wave one pairs is calculated by subtracting the estimated number of re-nesters from the total number of nests in the first wave. The number of wave two pairs is calculated by subtracting the estimated number of re-nesters from the total number of nests in the second wave.

Pre-term abandonment: Eggs or nests abandoned prior to the 21-day incubation.

Probable hatch: Eggs or nests which had no signs of depredation, but also did not have an observed chick. Assume to have likely hatched in the absence of signs of depredation to avoid over estimating depredation mortality.

Pair and Fledgling Number Calculations

A range of the number of breeding pairs in the colony was determined using CDFW reporting protocol (see definitions). The estimated number of total fledglings was determined by counting fledglings at each visit and using the "window surveys" described in CDFW protocol (Marschalek 2008). These window surveys occur approximately every three weeks. It is assumed that fledglings left the colony after three weeks and that each three-week period contained new fledglings.

RESULTS and DISCUSSION

In 2017, California Least Terns were first observed in the area of the Huntington State Beach colony on April 23. The first nests were located on May 5, the first chicks observed on May 26, and the first fledglings were observed on June 15. The last nest was located on August 1 and the last Least Terns were observed on August 8. A total of 679 nests were initiated, and produced a total of 706 chicks. No Western Snowy Plovers *(Charadrius nivosus nivosus)* were documented nesting on this site in 2017. As in previous years, nest distribution within the fenced area was concentrated in the east and north-east portions of the colony (Figure 2). No nests occurred outside the main fenced colony.

An estimated 540 to 593 Least Tern pairs initiated 679 nests at Huntington State Beach. Nesting chronology can be seen in figure 3. As observed in all years except 2013, there was a second wave in 2017, starting on June 13 with a total of 172 nests. An estimated 78 nests are assumed to be re-nesters, leaving a strong recruitment of approximately 100 first-time breeders. Terns typically start to breed in their third year, though two-year-old breeders have been documented. In 2014 this colony produced an estimated 168-348 fledglings, the highest seen in years immediately preceding that breeding season. This offers more evidence for the strong second wave seen in the 2017 breeding season. Out of 679 nesting attempts, 423 (62%) were successful, defined by at least one egg hatching, or probable hatch, defined as at least one egg having hatched without observation of a chick and no signs of depredation. From the 423 successful nests, 65% (706/1093) of eggs hatched or were probable hatches (Table 1). Of the 253 unsuccessful nests, 87 (34%) were depredated, 98 (39%) were abandoned pre-term, and 68 (27%) failed to hatch after full incubation (Figure 4). Another three nests (not included in mortality numbers) had

unknown outcomes. Many unhatched eggs (abandoned or non-viable) were scavenged at the end of the season.

The number of nesting attempts (679) in 2017 is the second highest since SAWA began monitoring this colony in 2008, with 2011 having 712 nesting attempts. On a statewide level there has been a downward trend, with individual colonies experiencing variations and fluctuations in total nesting attempts. The Huntington State Beach colony has experienced great fluctuation over the last ten years, with a high of 712 nest initiations in 2011, and a low of 347 initiations in 2013. The average number of nesting attempts has been 482 over 10 years, with a median of 444. Nesting success was 62% (423/679) in 2017 and has ranged from 59% in 2011 to 85% in 2012. Hatching success in 2017 was 65% (706/1093), which is lower than the average of 72% (5958/8290, standard deviation of 0.08) over the last ten years. Hatching success has varied from a low of 59% (708/1208) in 2011 to a high of 85% (805/949) in 2012. Lower hatching success at this colony can be associated with a higher predation rate. High depredation results not only in egg losses due directly to depredation, but also due to increased nest abandonment and infertility associated with the disturbance. The average clutch size in 2017 was 1.61 and has ranged from 1.27 in 2013 to 1.95 in 2010 (Table 1). The average first wave clutch size was 1.67 in 2017, and has ranged from 1.27 in 2013 to 1.96 in 2010. The average second wave clutch size was 1.44 in 2017, and has ranged from 1.23 in 2015 to 1.86 in 2010. Typically, the second nesting wave is associated with first-time breeders, and expected to show a lower clutch size average. At the Huntington State Beach colony, this expectation is not observed, with the average clutch sizes in the first and second waves being fairly similar.

Pre-term abandonment continues to be the highest cause of nest mortality. In 2017, 13% of nests failed due to this cause. In 2012, 24% of nests failed due to pre-term abandonment, the highest in the last 10 years; the lowest failure rate was 8% in 2014; over all years an average 15% (764/4989; SD 0.05) of all nests failed due to pre-term abandonment (Table 2). Ten percent of the nests that were incubated to term failed to hatch, which is the highest recorded in the last ten years. The lowest failure to hatch rate during this time was 1% in 2010 and 2011; an average 4% (207/4989; SD 0.03) of all nests during these years failed to hatch after incubation to term. Depredation is the second highest cause of nest failure, with 13% of failed nests in 2017 due to depredation. The lowest depredation rate was 0% in 2016, and the highest was 19% in 2011; over all years an average 7% (351/4989; SD 0.07) of all nests failed due to depredation. Nest failures due to depredation were primarily caused by American Crows (*Corvus brachyrhynchos*) and a rodent, most likely a rat (*Rattus* sp.). By extension, depredations can be associated with a higher than average rate of nest abandonment and non-viability. This is due to the disruption caused by the predators, especially when night predators (such as the rats) are present. Terns tend to be flightier and agitated with higher numbers of predators, leading them to flush more easily and stay off the nests longer, which can result in non-viability of eggs. They may also be more inclined to abandon their nests in the presence of a high predator population.

In addition to nest and egg losses due to predators, a pair of Peregrine Falcons (*Falco peregrinus*) and American Kestrels (*Falco sparverius*) worked the colony throughout the season. A total of ten chicks and three adults were documented taken by these predators. One kestrel, as well as a Cooper's Hawk (*Accipiter cooperi*), was trapped and removed from the area by a permitted contractor. Several

subsequent attempts to trap problematic falcons proved unsuccessful, but most depredations ceased after the capture of the first two raptors. Other potential predators observed in the area included Common Raven (*Corvus corax*), Osprey (*Pandion halieaetus*), Red-tailed Hawk (*Buteo jamaicensis*), Great Blue Heron (*Ardea herodias)*, Black-crowned Night Heron (*Nycticorax nycticorax*), European Starling (*Sturnus vulgaris*), gulls (*Larus* spp.), and domestic dogs (*Canis familiaris*). Adult terns were observed mobbing and chasing away potential predators from the colony.

An estimated 540 to 593 breeding pairs produced an estimated 26 to 140 fledglings (Table 3), yielding a fledgling per pair ratio of 0.04 to 0.26. This is one of the lowest fledgling to pair ratios since 2008, second only to 2009 (0.002 to 0.35). An estimated 0.70 ratio is considered necessary to maintain a breeding population (Fancher 1992). This rate has not been met at the Huntington State Beach colony since 2010. However, this does not necessarily demonstrate low productivity, as Least Tern fledglings are notoriously hard to count. Counting methods currently employed across the state are neither accurate nor consistent between colonies. Accurate counts are hard to acquire due to the mobile nature of fledglings, and the rapid rate at which they leave colonies. At the Huntington State Beach colony, a couple methods are used to determine the fledgling productivity range. The lower estimate was tallied using the CDFW pre-established "window survey" dates. This method tends to provide a lower estimate due to taking the number of fledglings observed closest to the date of each window survey. The higher fledgling estimate was acquired using a modified "window survey" method, by taking the highest count every two weeks, and using both the number of fledglings observed by the biologist monitors as well as the trained volunteers who walk outside the colony. Pre-fledges and younger fledges were used in these counts, while older fledges were excluded because they could be individuals dispersing from other colonies. Despite using two different methods to calculate fledgling production, these numbers are most likely still low in terms of actual production. The fenced colony is greater than eight acres, with additional area used by the terns outside the fence. It is almost impossible to achieve an accurate count with current staffing, especially during nest monitoring. In addition to monitoring limitations, the experimental monitoring without blinds could have contributed to the lower fledgling counts. Veteran monitors noted throughout the season the difficulty in counting chicks while walking the colony without blinds. As monitors walked through the colony, the chicks would settle down on the sand or under vegetation and freeze, which made them very difficult to detect. In previous years, chicks continued to run through the colony while monitors in blinds walked through, making them more visible and easier to detect. It is also likely that fledglings were reacting differently to monitors without blinds. Whether fledglings moved more or less in response to monitors outside of blinds, they would be more difficult to detect, and therefore more difficult to count.

INCIDENTAL OBSERVATIONS

In previous years, adult and fledgling Least Terns were observed loafing and preening just outside the colony fence along the beach strand. No terns were observed loafing or feeding in the Santa Ana River this year during the monitoring effort, likely due to the disturbances caused by people bringing their dogs to the river mouth for swimming. As in previous years, helicopters flying over the colony caused the terns

to flush. One banded tern was recovered after it died; the band number was reported. Biologists were unable to count other banded birds this year due to the new monitoring technique.

During the nesting season, several Killdeer *(Charadrius vociferous)* nested within the main fenced colony, and produced chicks throughout the season. Mourning Doves *(Zenaida macroura)*, House Finches (*Haemorhous mexicanus*), European Starlings (*Sturnus vulgaris*), and horned larks (*Eremophila alpestris*) were observed foraging in the colony throughout the season. Although not directly observed, starlings are a potential nest predator. Volunteers monitoring outside the colony observed Western Snowy Plovers (*Charadrius alexandrines nivosus*) on the beach from late April to early May and again from July to August. Other species documented around the colony included Elegant Tern *(Thalasseus elegans)*, Forster's Tern *(Sterna forsteri)*, Caspian Tern *(Hydroprogne caspia)*, Royal Tern (*Thalasseus maximus*), Western Gull *(Larus occidentalis)*, Ring-billed Gull (*Larus delawarensis*), Heermann's Gull *(Larus heermanni)*, Marbled Godwit *(Limosa fedoa)*, Willet (*Tringa semipalmata*), Sanderling (*Calidris alba*), Black-bellied Plover (*Pluvialis squatarola*), Semipalmated Plover (*Charadrius semipalmatus*), Black Turnstone (*Arenaria melanocephala*), Whimbrel (*Numenius phaeopus*), Western Sandpiper *(Calidris mauri)*, Black Skimmer *(Rynchops niger)*, Brown Pelican *(Pelecanus occidentalis)*, Common Loon (*Gavia immer*), Red-breasted Merganser (*Mergus serrator*), American Pipit (*Anthus rubescens*), White-faced Ibis (*Plegadis chihi*), Rock Pigeon (*Columba livia*), Double-crested Cormorant (*Phalacrocorax auritus*), Say's Phoebe (*Sayornis saya*), Barn Swallow (*Hirundo rustica*), and Eurasian Collared Dove (*Streptopelia decaocto*). The loons were not only observed in the surf, but several dead loons also washed ashore. Most of these species are unlikely to depredate Least Terns, but other tern species have been observed competing with the Least Terns for fish in previous seasons.

SUMMARY and CONCLUSIONS

Fledgling productivity and success varies from year to year, depending on factors such as depredation during the season, food availability, and seasonal fluctuations in weather, oceanic, and climate conditions. When SAWA began monitoring in 2008, a high rate of depredation of eggs by crows early in the season led to low hatching success. Despite the depredations, fledgling recruitment was considered favorable (estimated 267 fledglings). For undetermined reasons, fledgling production was low in 2009, but favorable in 2010 (estimated 132 and 298 fledglings, respectively). Since 2010, fledgling production has fallen. Between 2011 and 2013, an estimated 107, 90, and 100 fledglings were produced. Domoic acid, which is toxic to birds, was a suspected cause for the low productivity in 2011, while food shortages in 2012 and 2013 are suspected for low productivity in those years. Since 2013, there have been weak second wave nesting attempts. This is consistent with the low fledgling production since 2011. In 2017, hatching success was fairly low (65%), as was chick mortality with 171 documented chick deaths (706 eggs hatched or probable hatched). Most documented chick mortalities were due to unknown causes, while ten chicks were documented as depredated. A low estimate of 26 to 140 fledglings produced in 2017 follows the trend since 2011, excluding 2014. This low production will likely see a low second wave nesting effort in 2020. There was a strong second wave nesting attempt, compared to

previous years. This is consistent with the strong fledgling production seen in 2014 (168 to 348 fledglings, 0.35 to 0.79 fledglings per pair; Table 3).

Preventing significant predation by falcons and crows requires constant vigilance at the Huntington State Beach colony. Both species are relatively abundant in the urbanized coastal areas of southern California, relatively unpredictable in the timing of their appearance at Least Tern nesting areas, and are capable of precluding initial nesting and negatively affecting Least Tern reproductive success at a particular site. Efforts are being made to discourage falcon nesting in surrounding neighborhoods, by reaching out to local birding clubs to encourage property owners to keep palm skirts trimmed. Although ten chicks were documented as taken by falcons, the full impacts of these predators were unknown, because most depredations were probably not observed. Several rodent burrows were documented within the colony this year, and are suspected to be a high contributor to the higher predation seen on eggs and nests. Pre-season monitoring should include searches for burrows, and appropriate measures, such as trapping or smoke bombing, should be taken to eliminate this threat. Additional measures to preclude rodents, such as better trash management in the surrounding area, are being explored. When examining Least Tern nest failure at this site over the last ten years, pre-term abandonment appears to be the primary cause of nest failure (Figure 4). Predator presence may play a role in early abandonment, but other factors, notably food availability, are certainly important as well.

Managing disturbances that can significantly reduce the productivity of a major tern colony is imperative to the survival and recovery of this species. Recruitment of new individuals is crucial to sustaining the breeding population, and it can be set back several years or completely by major stochastic events. While cyclical weather patterns such as El Niño and La Niña events cannot be prevented, measures can be taken to reduce the effects of such events on reproductive output. Maintaining as many nesting sites as possible throughout the state will not only aid in increasing the population as a whole, but will also reduce the risk of any one stochastic event wiping out a large portion of the tern population. This strategy is important locally as well. In certain years, terns have moved en masse from one site with major issues to another and bred successfully. Improved management of the Newport Slough site to keep it suitable for Least Tern nesting, along with maintaining the Huntington State Beach colony site and other local options, should be considered critical to the recovery of the species.

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Photo credit: Nicole Housel

Figure 1. Huntington State Beach California Least Tern breeding colony and labeled grids.

Figure 2. California Least Tern nest distribution inside the main colony at the Huntington State Beach site, 2017.

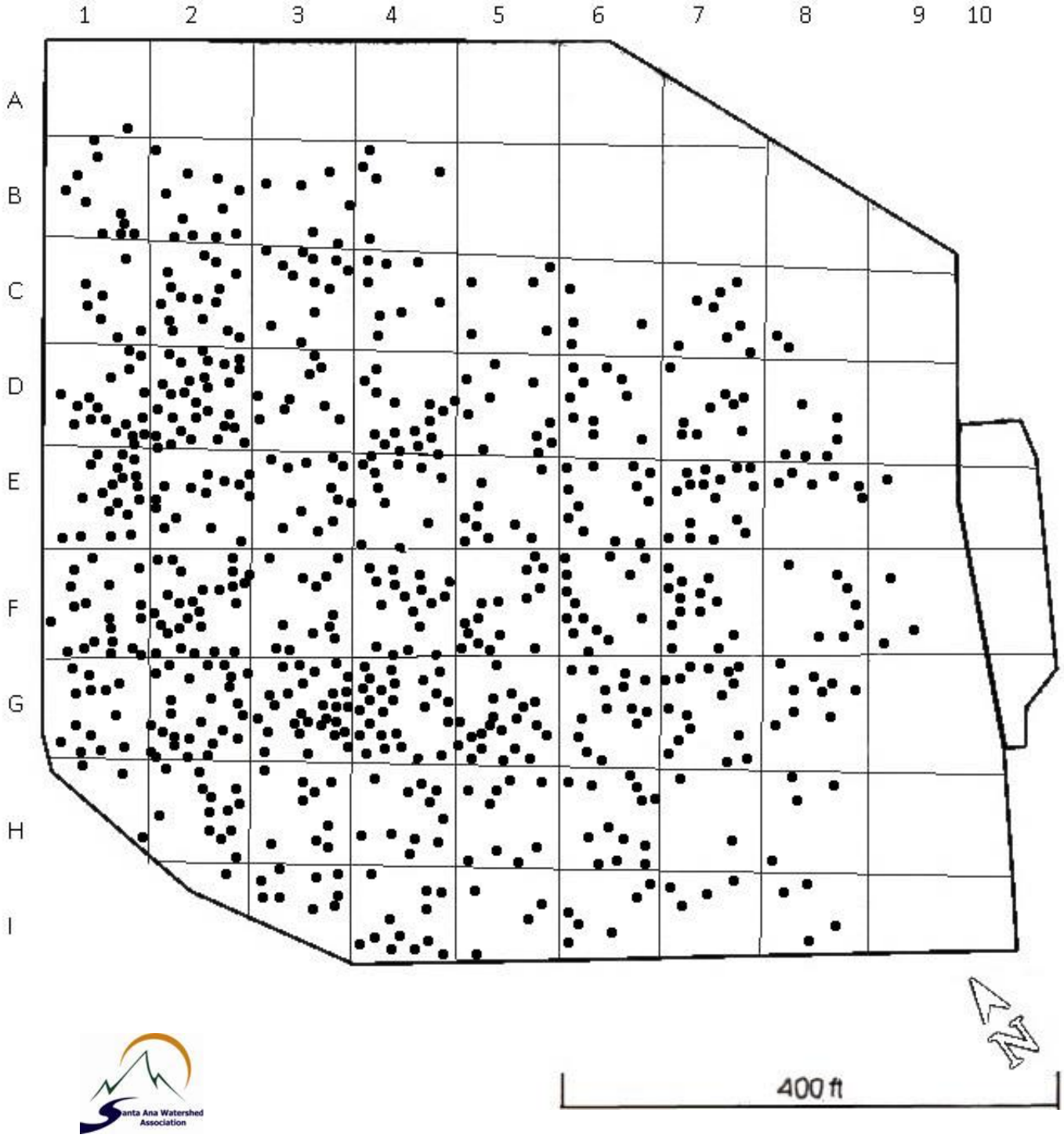

Figure 3. California Least Tern nesting chronology by week at the Huntington State Beach colony, 2017.

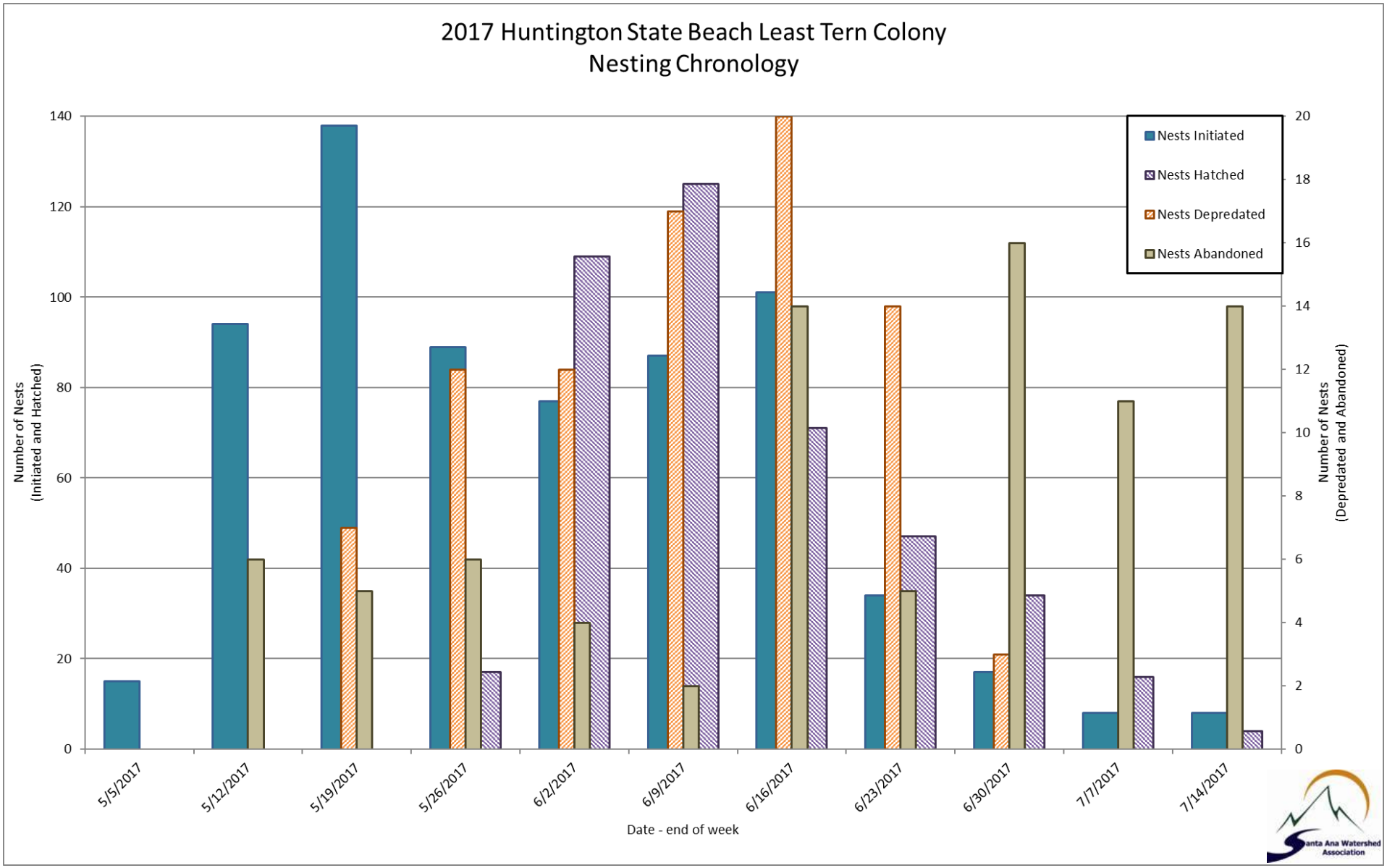

Figure 4. A ten-year comparison of California Least Tern nest failure at the Huntington State Beach Park colony.

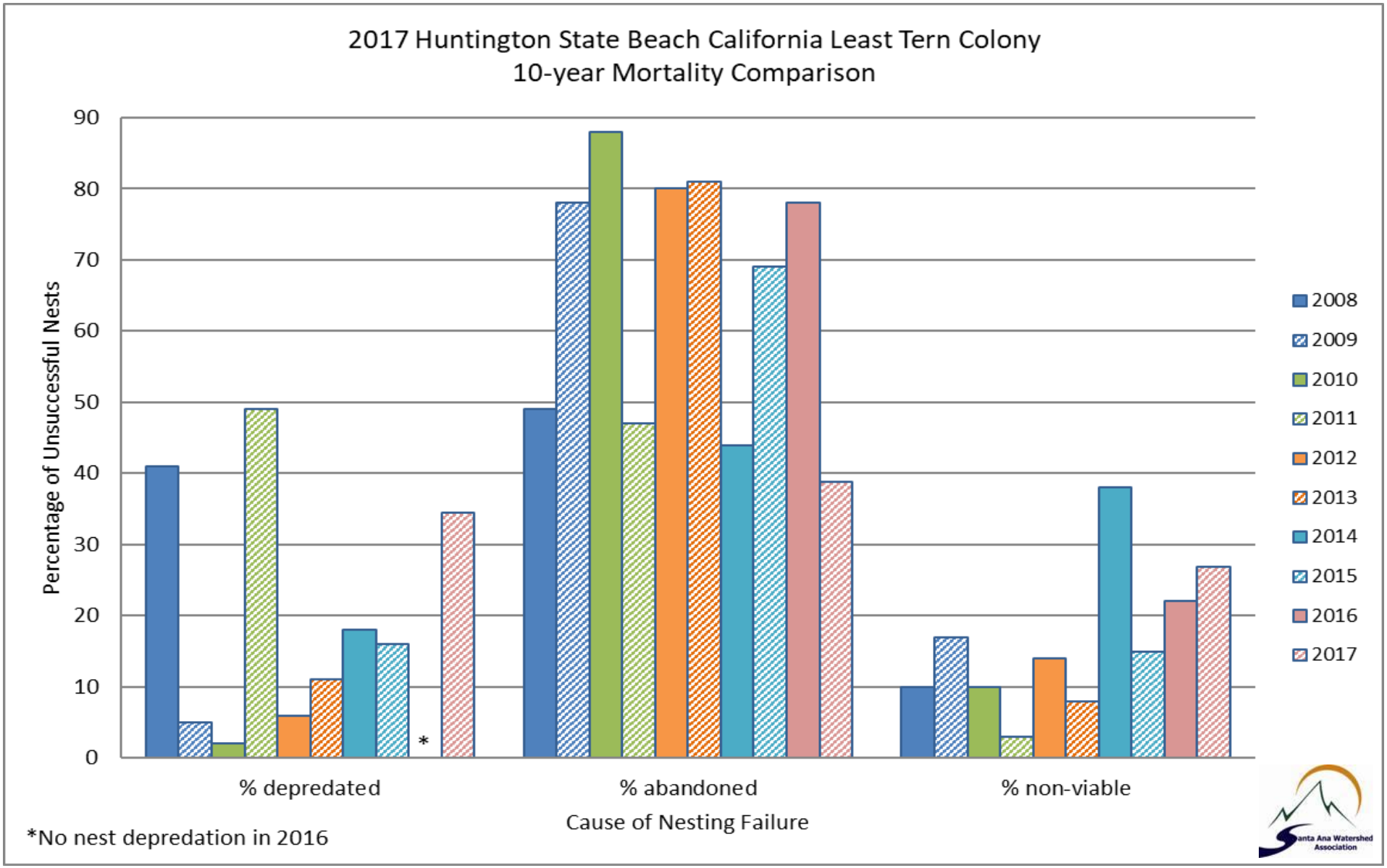

Table 1. California Least Tern nest, clutch size, and hatching data on Huntington State Beach, 2008-2017.

Year	Wave	Number of Nests	Clutch Size								Mean Clutch Size	SD	Nesting Success in %
			1-egg		2-egg		3-egg		4-egg				
			#	%	#	%	#	%	#	%			
2008	Total	454	170	37%	283	62%	1	<1%	0	0%	1.63	0.49	62%
	1st wave	366	133	36%	232	63%	1	<1%	0	0%	1.64	0.49	
	2nd wave	88	37	42%	51	58%	0	0%	0	0%	1.58	0.49	
2009	Total	434	111	26%	321	74%	2	<1%	0	0%	1.75	0.44	76%
	1st wave	391	86	22%	303	77%	2	<1%	0	0%	1.79	0.42	
	2nd wave	43	25	58%	18	42%	0	0%	0	0%	1.42	0.49	
2010	Total	433	34	8%	388	90%	11	<1%	0	0%	1.95	0.32	81%
	1st wave	363	24	7%	328	90%	11	<1%	0	0%	1.96	0.31	
	2nd wave	70	10	14%	60	86%	0	0%	0	0%	1.86	0.35	
2011	Total	712	220	31%	489	69%	2	<1%	1	<1%	1.69	0.47	59%
	1st wave	701	214	31%	484	69%	2	<1%	1	<1%	1.69	0.47	
	2nd wave	11	6	55%	5	45%	0	0%	0	0%	1.45	0.50	
2012	Total	542	136	25%	405	75%	1	<1%	0	0%	1.75	0.44	85%
	1st wave	525	129	25%	395	75%	1	<1%	0	0%	1.76	0.43	
	2nd wave	17	7	41%	10	59%	0	0%	0	0%	1.59	0.49	
2013	Total	347	252	73%	95	27%	0	0%	0	0%	1.27	0.45	69%
	1st wave	347	252	73%	95	27%	0	0%	0	0%	1.27	0.45	
	2nd wave	No discernible second wave											
2014	Total	516	183	35%	332	64%	1	<1%	0	0%	1.65	0.48	80%
	1st wave	483	160	33%	322	67%	1	<1%	0	0%	1.67	0.47	
	2nd wave	33	23	70%	10	30%	0	0%	0	0%	1.30	0.46	
2015	Total	524	199	38%	324	62%	1	<1%	0	0%	1.62	0.49	73%
	1st wave	489	172	35%	316	65%	1	<1%	0	0%	1.65	0.48	
	2nd wave	35	27	77%	8	23%	0	0%	0	0%	1.23	0.42	
2016	Total	348	142	41%	205	59%	0	0%	1	<1%	1.59	0.51	76%
	1st wave	324	127	39%	196	60%	0	0%	1	<1%	1.60	0.51	
	2nd wave	24	15	63%	9	38%	0	0%	0	0%	1.38	0.48	
2017	Total	679	269	40%	406	60%	4	<1%	0	0%	1.61	0.50	65%
	1st wave	507	172	34%	331	65%	4	<1%	0	0%	1.67	0.49	
	2nd wave	172	97	56%	75	44%	0	0%	0	0%	1.44	0.50	

Table 2. California Least Tern nest loss at Huntington State Beach, 2008-2017.

Year	Cause of Nest Mortality						Total Percentage of all nests lost
	Predation		Abandoned (pre-term)		Failed to Hatch (incubated post-term)		
	Number of nests/Total	Percentage	Number of nests/Total	Percentage	Number of nests/Total	Percentage	
2008	71/454	16%	86/454	19%	17/454	4%	39%
2009	5/434	1%	77/434	18%	17/434	4%	23%
2010	1/433	<1%	46/433	11%	5/433	1%	13%
2011	134/712	19%	128/712	18%	9/712	1%	38%
2012	4/542	1%	52/542	10%	9/542	2%	13%
2013	11/347	3%	84/347	24%	8/347	2%	29%
2014	17/516	3%	42/516	8%	36/516	7%	18%
2015	21/524	4%	89/524	17%	20/524	4%	25%
2016	0/348	0%	62/348	18%	18/348	5%	23%
2017	87/679	13%	98/679	14%	68/679	10%	37%
Average	351/4989	7%	764/4989	15%	207/4989	4%	26%
Standard Deviation	19.69		28.22		9.59		52.90

Table 3. California Least Tern pair and fledgling estimates at Huntington State Beach, 2008-2017.

Year	Pairs	Fledglings	Fledglings per Pair	Total Pairs Statewide
2008	344 to 411	267[a]	0.65 to 0.78	7067 to 7513
2009	379 to 413	132	0.002 to 0.348	7130 to 7352+
2010	398 to 405	298	0.74 to 0.75	6437 to 6699+
2011	518 to 707	107	0.15 to 0.21	4931 to 6153
2012	422 to 534	90	0.17 to 0.21	4595 to 6155
2013	311 to 347	100	0.29 to 0.32	4352.5 to 5560.5
2014	439 to 479	168 to 348	0.35 to 0.79	4232 to 5786
2015	422 to 506	125	0.25 to 0.30	4202 to 5295
2016	292 to 336	100 to 123	0.30 to 0.42	3989 to 4661
2017	540 to 593	26 to 140	0.04 to 0.26	TBA

[a]moderate egg predation by crows

Appendix A: California Least Tern Aging Classification for Chicks and Fledglings

Downy chick: No pin feather present, and less than a week old. For our working purposes, those chicks still in the nest or associated with a nest are considered "downy chicks".

Feathered chick: This age class starts when the first pin feathers erupt from the skin. This first occurs on the wings, and will not be visible in most field observations. For our working purposes, if the chick is a "runner" and no longer associated with a nest, it will be classified as a "feathered chick".

Pre-fledge: Facial mask is beginning to show. Mostly feathered, may still have some down (especially around the head, giving it the appearance of having "old man hair"), but is not yet able to fly. Flight feathers are equal in length to the tail feathers. Less than one week to fledging.

Younger fledge: Just starting to be able to fly. Has a full facial mask. Still has a very brownish appearance (especially on head and back). Flight feathers are longer than the tail feathers.

Older fledge: Flying well and is starting to or has left the colony. May still be fed by adults, but is learning to forage. More gray coloration, though may still retain some brown. Flight feathers are longer than the tail feathers.

References: 01/17/14 CDFW California Least Tern Information and Coordination Meeting. Minutes distributed 02/19/14.